AN INTEGRATED APPROACH TO THE RENEWABLE ENERGY ASSESSMENT

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Actuality for assessing environmental aspects of alternative energy in Russia is due to the fact that development of renewable energy sources (RES) is regarded as one of the strategic directions of the "New Energy Strategy of Russia until 2030". It is expected that the contribution of RES to the country energy balance will be increased up to 4.5% in 2020.

However, despite the active support of the Russian Government, the future development of alternative energy sources is still constrained by rather low technical and economic potentials of renewable energy. In addition, its environmental impact is primarily assessed on the stage of operation, which could lead to suboptimal solutions in the planning of renewable energy.

For this purpose, we propose to consider an integrated approach to the renewable energy assessment based on the life cycle of energy production from RES including all stages, from construction of a wind power unit (including extraction of raw materials, production of intermediate products, construction and transport) till use of equipment (including its energy consumption, transport, maintenance and repairs) and ending with recycling and disposal of waste.

The purpose of this presentation is to determine the environmental aspects of electricity generated from renewable energy sources, based on consideration of the life cycle assessment to select the best technology.

The object of the study is 5 kW wind power plant (WPP) which was produced in Russia. The considered wind turbines can be used by autonomous power consumers, such as households, farms, mini-bakeries and other facilities located in countryside areas.

The subject of the study is assessing the environmental impact and resource efficiency of wind energy at the stages of production, operation, energy distribution and the decommissioning at the end of life.

Comprehensive study of the life cycle of a product or service is necessary because it is not always clear what kind of influence was exerted on the environment during production, and which one at the use stage of the product system.

We suggest the following procedure to choose the best available technology based on renewable energy, which consists of the following basic steps:

1. Data collection and definition of a product system;
2. Inventory of input and output impacts;
3. The balance scheme "costs - release" for materials and energy within the boundaries of the production system;
4. Analysis of input material flows and analysis of resource efficiency of renewable energy production system by its stages;
5. Analysis of the output material flows and determination of significant environmental impact categories;
6. Interpretation of the results;
7. Economic evaluation of RES, and
8. Determining the best available technology of renewable energy.

On the basis of pollutants specific quantities emitted into the air within the life cycle of 1 kW energy power production by the Russian wind turbine VEY-5 the environmental impact categories have been calculated. The calculation was performed using the software LCALtools.

The results are presented at Fig. 1. The maximum contribution to global warming potential (GWP) are making by methane (97.8%). The maximum share of photochemical smog formation belongs to emissions of non-methane hydrocarbons (92.8%).

Since renewable energy sources are still considered to be one of possible directions of the energy supply diversification it is important to use an integrated approach and examine not only environmental but also economic impact of wind energy in comparison with other renewable energy sources.

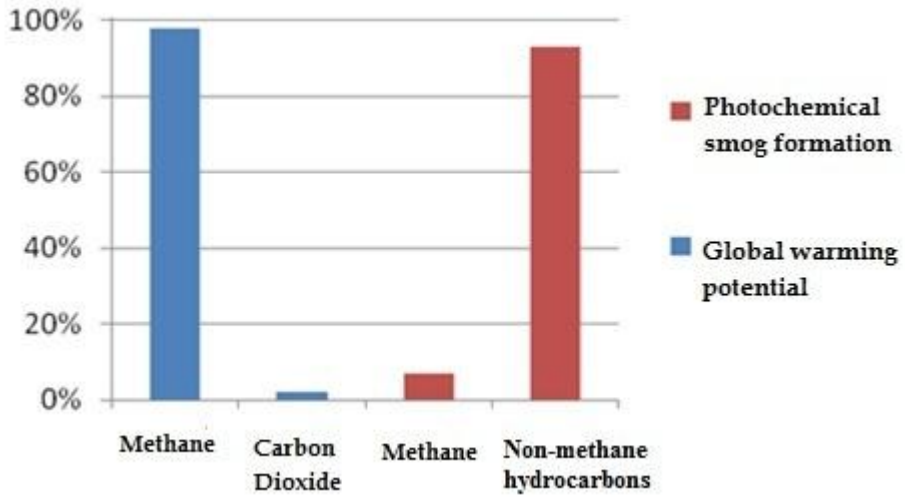

Figure 1. Shares of the pollutant substances within the environmental impact categories in the production of electricity by wind installation type VEY-5

Questions for further research relate to the application of the life cycle cost analysis of wind power units. In conjunction with the analysis of resource efficiency and life cycle assessment this approach can help to make a reasoned decision about the feasibility of using this alternative energy source and to avoid making wrong decisions.